English Sole Tagging in Hecate Strait, *R/V G. B. Reed*, June 6–24, 1983

J. Fargo, R. P. Foucher, S. C. Shields, and D. Ross

Department of Fisheries and Oceans
Fisheries Research Branch
Pacific Biological Station
Nanaimo, B. C. V9R 5K6

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These reports provide a medium for filing and archiving data compilations where little or no analysis is included. Such compilations commonly will have been prepared in support of other journal publications or reports. The subject matter of Data Reports reflects the broad interests and policies of the Department of Fisheries and Oceans, namely, fisheries management, technology and development, ocean sciences, and aquatic environments relevant to Canada.

Numbers 1-25 in this series were issued as Fisheries and Marine Service Data Records. Numbers 26-160 were issued as Department of Fisheries and the Environment, Fisheries and Marine Service Data Reports. The current series name was changed with report number 161.

The correct citation appears above the abstract of each report.

Rapport statistique canadien des sciences halieutiques et aquatiques

Ces rapports servent de base à la compilation des données de classement et d'archives pour lesquelles il y a peu ou point d'analyse. Cette compilation aura d'ordinaire été préparée pour appuyer d'autres publications ou rapports. Les sujets des Rapports statistiques reflètent la vaste gamme des intérêts et politiques du Ministère des Pêches et des Océans, notamment gestion des pêches, techniques et développement, sciences océaniques et environnements aquatiques, au Canada.

Les numéros 1 à 25 de cette série ont été publiés à titre de Records statistiques, Service des pêches et de la mer. Les numéros 26-160 ont été publiés à titre de Rapports statistiques du Service des pêches et de la mer, Ministère des Pêches et de l'Environnement. Le nom de la série a été modifié à partir du numéro 161.

Le titre exact paraît au haut du résumé de chaque rapport.

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ENGLISH SOLE TAGGING IN HECATE STRAIT, R/V G.B. REED, June 6-24, 1983

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Department of Fisheries and Oceans

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ABSTRACT

Fargo, J., R. P. Foucher, S. C. Shields, and D. Ross. 1984. English sole tagging in Hecate Strait, R/V G.B. REED, June 6-24, 1983. Can. Data Rep. Fish. Aquat. Sci. No. 427: iii + 49 p.

English sole (Parophrys vetulus) were tagged aboard the research vessel G.B. REED in Hecate Strait during June 1983. The primary purpose of the tagging experiment was to validate age determination methods for the species. Tagging took place on 3 major fishing grounds in International Areas 5C and 5D.

A total of 5376 fish were tagged, injected with oxytetracycline (intramuscular) for age validation, and released. Immediate post-tagging mortality for the experiment was estimated at 0.01. Secondary activities included collecting length-weight data for English sole, collecting data on Pacific cod (Gadus macrocephalus) size and age composition, vertical water temperature profiles, vertical and surface plankton tows and sampling bottom sediment types.

Key words: English sole tagging, age validation, temperature profiles, plankton hauls, surficial sediments, types.

RÉSUMÉ

Fargo, J., R. P. Foucher, S. C. Shields, and D. Ross. 1984. English sole tagging in Hecate Strait, R/V G. B. REED, June 6-24, 1983. Can. Data Rep. Fish. Aquat. Sci. No. 427: iii + 49 p.

En juin 1983, des soles anglaises (Parophrys vetulus) capturées dans le détroit d'Hécate ont été étiquetées à bord du navire de recherche G. B. REED. Cette expérience visait principalement la validation des méthodes de détermination de l'âge de l'espèce. L'étiquetage a été effectué dans trois importantes pêcheries situées dans les zones internationales 5C et 5D.

Au total, 5376 poissons one été étiquetés, injectés d'oxytétracycline (injection intramusculaire) pour valider l'âge, puis relâchés. On a évalué le taux de mortalité immédiatement après l'étiquetage à 0,01. Les activités secondaires ont consisté en la collecte de données sur la longueur en fonction du poids des soles anglaises et sur la taille et la répartition des âges de la morue du Pacifique (Gadus macrocephalus), en la détermination des profils verticaux de la température de l'eau, des levés verticaux et en surface du plancton et en l'échantillonnage des sédiments.

INTRODUCTION

Age validation is one problem of primary concern to sequential population analyses used as stock assessment tools for English sole (Parophrys vetulus) in Hecate Strait.

Recent innovations in ageing techniques at the Pacific Biological Station (Chilton and Beamish 1982) have indicated a longer life span (d21 yr) for English sole than previously believed. The new ageing techniques have the effect of increasing the number of age groups subject to fishery exploitation, and reducing estimates of natural mortality rates for the species.

New ageing techniques are unvalidated for English sole although they have been validated for other groundfish species using oxytetracycline (OTC) (Chilton and Beamish 1982).

A tagging experiment for English sole was designed to provide validation for ageing techniques using OTC. This report summarizes results of the tagging operation carried out in Hecate Strait June 6-24, 1983, as well as the ancillary projects undertaken.

MATERIALS AND METHODS

VESSEL AND FISHING GEAR

The research vessel G.B. REED was used for the English sole tagging experiment. The net used was a modified Eastern trawl (Fig. 1) with a 33.2-m (109-ft) rubber disc groundline. The net was fished with 64-m (35-fath) sweeplines and 635-kg (1400-lb) Brompton doors.

FISHING PROCEDURE

Fishing locations were based on the best catch rates for English sole observed on the April 1983 flatfish survey of Hecate Strait (Fargo et al. 1983), as well as commercial landing statistics. Haul duration was adjusted to obtain an optimum (d 400) number of fish for tagging.

Once the codend was brought aboard, fish were immediately dumped into a large checker flooded with water. English sole in the catch were picked by hand from the checker, placed into plastic tubs (d12 fish/tub) and transferred to two small holding tanks (780-L capacity) and one larger holding tank (1400-L capacity) when necessary. A maximum of ≈100 fish were placed in each of the smaller tanks while 200-300 fish were held in the large holding

tank. Excess numbers of English sole in the catch were discarded. Estimates of the total catch and species percent composition were made by eye so as not to slow down the tagging operation.

TAGGING

The tag type used was a Floy FD68B (9.5 cm long -- 2.5 cm nylon shank attached to 7.0-cm length of #20 yellow vinyl tubing). The tags were inserted in the mid-body region of the eyed side of the fish midway between the lateral line and dorsal fin.

Each fish selected from the catch for tagging was examined for injuries and, if acceptable, measured fork length to the nearest cm (fish <25 cm were rejected), tagged, injected with oxytetracycline and placed in a recovery tank (1748-L capacity) hinged to the vessel rail. A constant supply of fresh seawater was pumped to the recovery tank via deck hose.

Anesthetic was not used during the course of the experiment.

When the recovery tank's holding capacity was reached (~500-600 fish), tagged fish were released by tilting the recovery tank overboard, dumping tagged fish and holding water simultaneously. This procedure is fully outlined by Harling et al. (1982).

A constant supply of seawater was provided to each holding tank as well as the recovery tank via deck hoses with flow diffusing nozzles. Each holding tank was drained and refilled after each haul when tagging was completed.

OTC INJECTION FOR AGE VALIDATION

Oxytetracycline was injected into tagged English sole to validate age determination. Injections were intramuscular and posterior to the point of tag insertion. This location seemed to minimize loss of OTC after injection.

The dosage of OTC used, .25 cc/kg body wt. was derived from results of a series of laboratory experiments on English sole conducted prior to the tagging. Weight of individual fish was calculated according to the formula $W = 0.0143\ L^{2.86}$ where W = grams, L = centimeters, (sexes combined) (unpublished 1979 data). Dosages were assigned to length intervals with homogeneous weights as follows:

Size range (cm)	Dosage (cc)
25-32	0.05
33-38	0.10
39-43	0.15
44-47	0.20
48-51	0.25

OTC was administered using auto-loading pipettes graduated to 0.1 cc. Length intervals on measuring boards were marked with appropriate dosage levels to aid taggers.

PRE-RELEASE MORTALITY

On one occasion, tagged fish were held overnight in the recovery tank to assess immediate post-tagging effects. The next day, all dead fish were removed from the recovery tank, tag numbers recorded and live fish released.

BIOLOGICAL SAMPLING

Upon completion of the tagging experiment a sample of English sole was collected to derive additional length-weight relationships. Each fish was sexed, measured for fork length to the nearest cm and weighed to the nearest gram.

An electronic digimetric scale was used for recording weights (averaged from 10 weighings electronically). All weight measurements were taken at anchor in calm water to minimize effects of vessel roll and engine vibration on weighings.

Length frequencies were collected from incidental catches of Pacific cod during the trip, as well as a stratified sample of fin rays.

OCEANOGRAPHIC SAMPLING

Oceanographic stations were occupied on the trip out as well as the return trip (Fig. 2). Stations were monitored for vertical temperature profiles with XBT.

Plankton samples were collected with a SCOR net with 350$^{\mu}$ mesh used for vertical tows and a neuston sampler with 500$_{\mu}$ mesh used for surface tows. All plankton samples were labelled (Station #, date, location) and preserved in 10% buffered formalin for future processing at PBS.

GEOLOGICAL SAMPLING

A series of tracklines (Fig. 3) were laid out and surficial sediments were sampled at pre-selected intervals with a Shipek bottom grab. Initially, stations were established at 5 M intervals. If bottom type changed

dramatically, additional stations were established. Qualitative data on bottom sediment types was recorded after each grab. Detailed analysis will be undertaken by geologists at the Geo-Science Center, Patricia Bay, B.C.

RESULTS

GENERAL

A total of 26 hauls were made in 3 principal localities in International Areas 5C and 5D (Fig. 3). Principal species caught included:

Species	Estimated wt (kg)[a]	% of total catch
English sole	3839	38.1
Turbot	1781	17.7
Halibut[b]	1077	10.7
Dogfish	1032	10.2
Pacific cod	415	4.1
Rex sole	414	4.1
Walleye pollock	352	3.5
Ratfish	213	2.1
Rock sole	205	2.0
Invertebrates	205	2.0
Dover sole	109	1.1
Sablefish	102	1.0
Others[c]	340	3.4
Total	10,084	100.0

[a]Based on an estimated percentage of each species in the total catch of each haul where the weight of the total catch was estimated by the chief scientist.

[b]Halibut caught were measured and released.

[c]Individual totals for other species were <1.0% of the total catch.

A detailed summary of haul locations and catch composition is contained in Appendix table 1. Scientific and common names of species caught are listed in Appendix table 2.

TAGGING

A total of 5376 English sole were tagged, injected and released during the tagging experiment. A total of 57 dead fish were removed from the recovery tank and length measurements of 14 tagged fish were not recorded.

Length frequencies of tagged fish by haul are listed in Appendix table 4. A summary of the length frequency of all fish tagged is contained in Fig. 4.

Tag number series used during the experiment were F82039225 - F82041999 and F8297000 - F8299819. A summary of tag numbers by haul is included in Appendix table 3.

Condition of fish at the time of tagging is summarized by tagging area in Table 1. Percent incidence of injuries was highest in the Butterworth area. This was probably because of the large incidental catch of starfish which tended to cause abrasions on fish species in the same hauls.

OTC INJECTION FOR AGE VALIDATION

Loss of OTC after injection was experienced intermittently at the beginning of the tagging experiment. Moving the point of OTC injection posterior to the point of tag implanting seemed to minimize this problem. If the amount of OTC loss after injection was close to the total amount injected, a second injection was made and the loss was not recorded.

PRE-RELEASE MORTALITY

From haul 9, 148 fish were held overnight in the recovery tank to assess post-tagging effects. The following morning the condition of these fish was examined, and all dead fish removed from the tank and their tag numbers noted. The dead fish accounted for 1.4% of the total number of fish kept in the recovery tank. No sluggishness was noted in any of the remaining fish in the recovery tank. Fish bleeding from tag wounds the previous day showed no signs of bleeding after 14 hours.

BIOLOGICAL SAMPLING

A sample collected from Haul 26 in the White Rock area was used to develop length-weight relationships for English sole in that area. Previous length-weight data had been collected for English sole in the Butterworth area.

Standard regression methods (log transformation) were used to fit the data to the equation $W = aL^b$. Predictive formulas were $W = 8.36 \times 10\text{-}3\ L3.01$ for males and $W = 6.13 \times 10^{-3}\ L3.10$ for females (length in centimeters and weight in grams). Fitted curves are shown in Fig. 5 for males and Fig. 6 for females. Regression formulas previously derived for English sole at Butterworth (1979 sample) were $W = 1.03 \times 10^{-2} L2.88$ for males and $W = 1.02 \times 10^{-2} L2.89$ for females, where weight is in grams and length in centimeters. The Butterworth sample included very few fish >35 cm. Length-weight data summaries for both Butterworth and White rocks samples are presented in Appendix table 5.

Fin rays were collected from 91 Pacific cod (Table 3) and length measurements were taken for 854 fish. Pacific cod is listed in Table 3. Pacific cod length frequencies by haul are contained in Appendix table 6.

OCEANOGRAPHIC SAMPLING

A summary of surface and bottom temperatures by area is contained in Table 2. A detailed summary of vertical temperature profiles by station is listed in Appendix table 7.

GEOLOGICAL SAMPLING

A summary of surficial sediment samples is listed in Appendix table 8. The majority of bottom grabs taken were in the 10-20 fath depth range and bottom sediments were generally shelly sand and sandy gravel interspersed with patches of coral. The trackline scheme proved to fit the bottom dynamics well as few extra grabs needed to be taken.

MISCELLANEOUS

An investigator from the National Museum was aboard to collect marine leeches associated with fish species on the Pacific coast and to collect other marine invertebrate specimens for the museum. A list of scientific and common names for invertebrates captured on the cruise is contained in Appendix table 9. Identifications were made by staff of the National Museum of Natural Sciences in Ottawa, Ontario.

An ornithologist from the Canadian Wildlife Service collected data on abundance and associations of seabirds found on B.C. inshore waters.

A researcher from INPFC was aboard to photograph fish species caught to supplement a publication reviewing marine fishes in the north Pacific Ocean.

PERSONNEL

J. Fargo (i/c)	PBS	June 6-24, 1983
R. P. Foucher	PBS	June 6-24, 1983
Shelley Shields	PBS	June 6-24, 1983
Don Ross	PBS	June 6-24, 1983
Jaqueline Madill	Nat. Museum, Ottawa	June 6-24, 1983
Yves Turcotte	Canadian Wildlife Service	June 6-24, 1983
Shuichi Takehama	INPFC	June 6-19, 1983

REFERENCES

Chilton, D. E. and R. J. Beamish. 1982. Age determination methods for fishes studied by the Groundfish Program at the Pacific Biological Station. Can. Spec. Publ. Fish. Aquat. Sci. 60: 102 p.

Fargo, J., J. Cooper, G. C. Hope, and S. J. Westrheim. 1983. Trawl survey of juvenile flatfish in Hecate Strait by the M/V DOUBLE DECKER, April 12-29, 1983. Can. Data Rep. Fish. Aquat. Sci. (In Press).

Harling, W. R., R. P. Foucher, and M. W. Saunders. 1982. Rock sole tagging in Hecate Strait, April 27-May 11, 1982. Can. Data Rep. Fish. Aquat. Sci. 355: iii + 54 p.

Stocker, M., J. Fargo, and D. M. A. Bennet. 1980. Dover sole tagging, Eastern Dixon Entrance, September 18-29, 1979. Can. MS Rep. Fish. Aquat. Sci. 1565: 50 p.

Table 1. Injuries to tagged English sole by locality, R/V G.B. REED, June 6-24, 1983.

Area	No. tagged	% injured by type									Total % injured
		Bleeding	Cut or wound	Dropped	Fin	Scale Loss	Scar	Other	Multiple injuries	Extruded gut	
Horseshoe	836	4.9	0.1	1.4	0.5	1.3	-	0.1	0.4	0.2	8.9
White Rocks, Bonilla	4251	1.7	0.2	1.0	0.8	0.8	0.1	-	0.2	0.5	5.3
Butterworth	346	3.8	-	0.9	2.0	2.3	0.3	-	1.4	-	10.7

Table 2. Water temperature data (XBT) G.B. REED cruise, June 6-24, 1983.

Area	Average bottom depth (m)	Surface temp (°C)		Bottom temp (°C)		n
		min.	max.	min.	max.	
Queen Charlotte Sound	299.6	12.4	14.5	5.0	6.7	10
Hecate Strait	122.1	11.0	14.0	5.6	11.5	8
Dixon Entrance	215	10.5	10.5	6.7	6.7	1

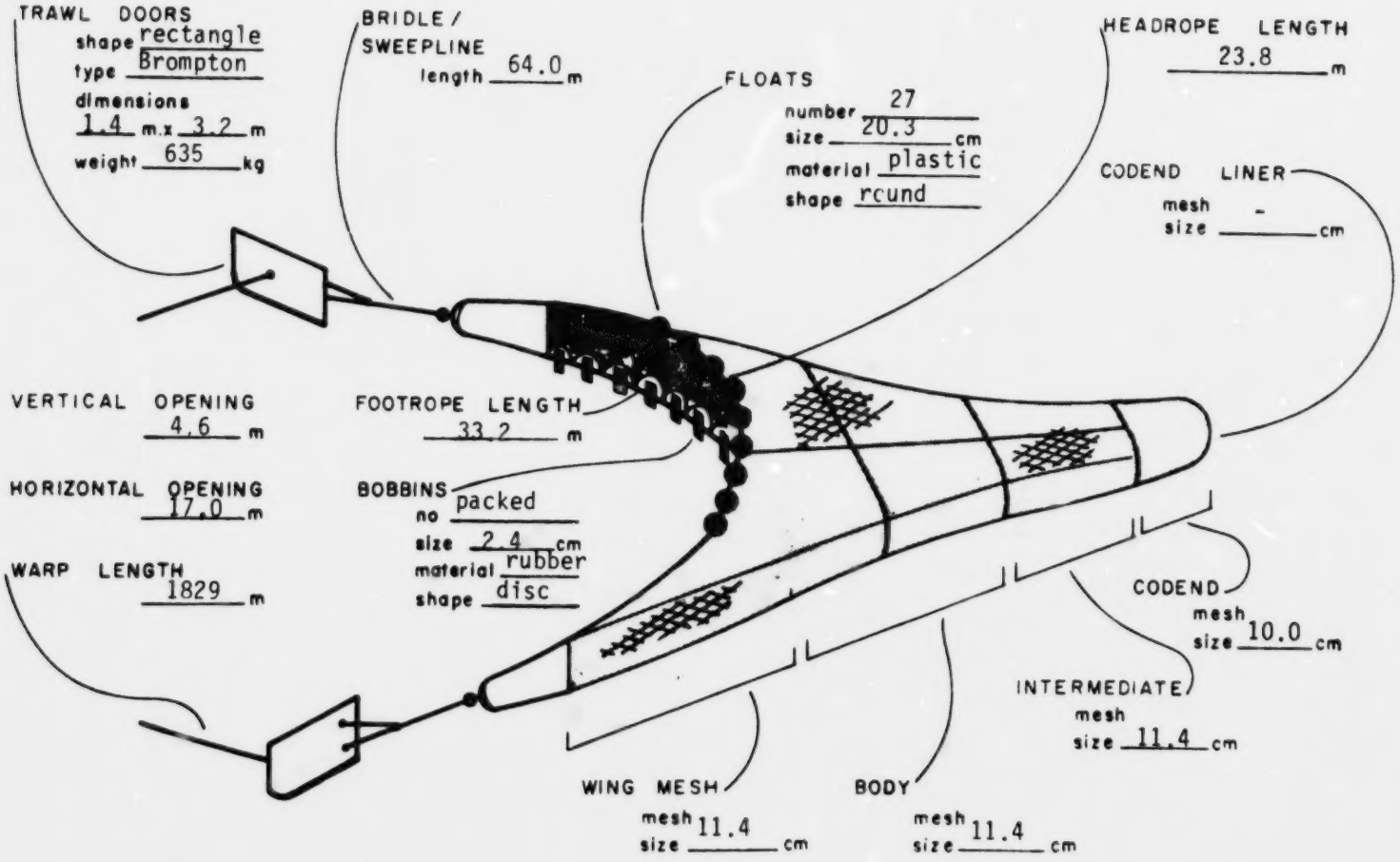
Table 3. Pacific cod sampling summary (fin rays), R/V G.B. REED, June 6-24, 1983.

Length interval (cm)	No. sampled (fin rays)
20	-
23	-
26	5
29	5
32	5
35	5
38	5
41	5
44	4
47	5
50	5
53	5
56	5
59	5
62	5
65	5
68	3
71	5
74	2
77	2

Fig. 1. NET DIMENSIONS AND CHARACTERISTICS FOR BOTTOM TRAWL

VESSEL G.B. REED NET modified Eastern trawl

OBSERVATION PERIOD June 6-24, 1983



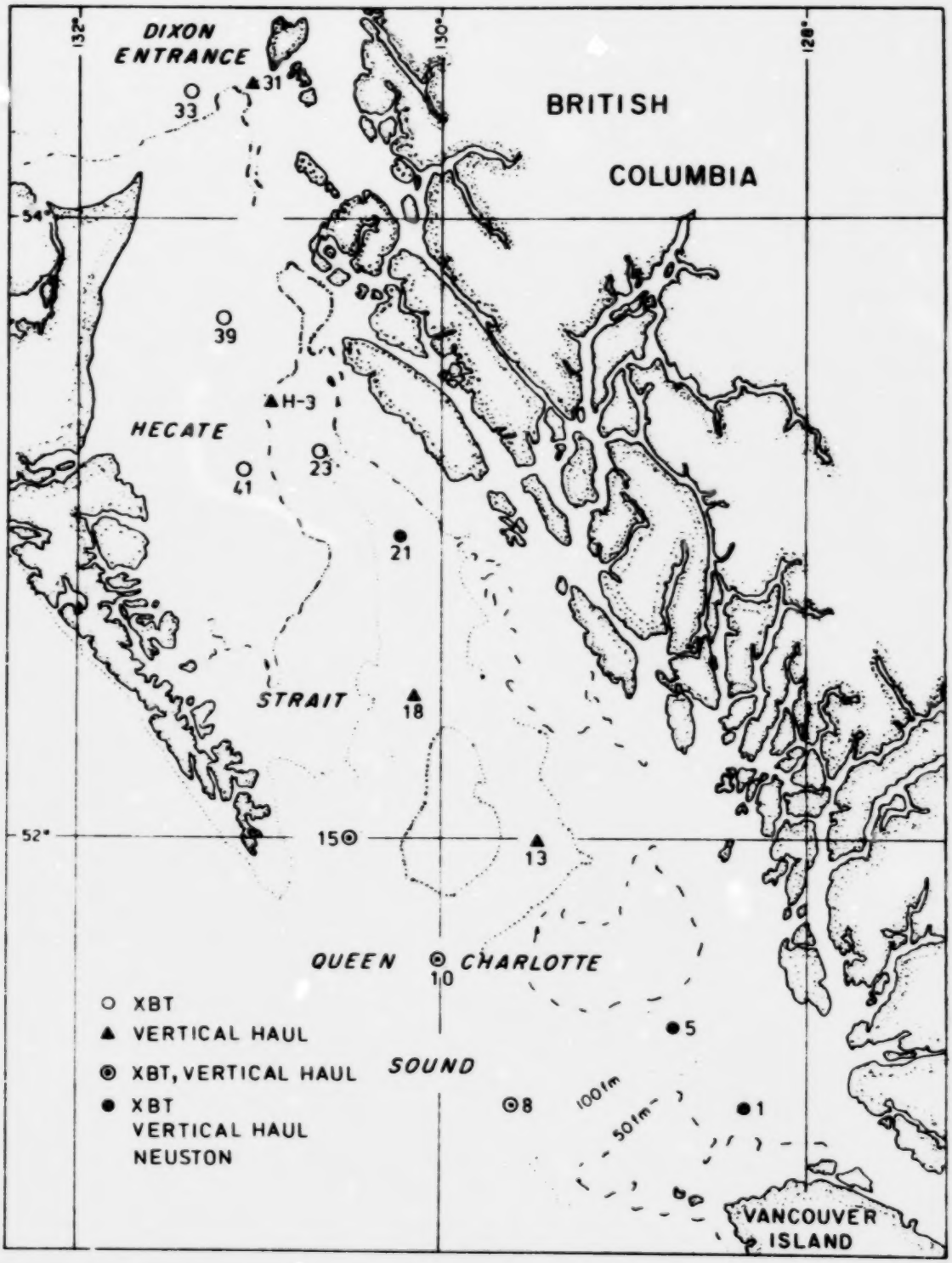


Fig. 2. Oceanographic stations occupied by R/V G.B. REED, June 6-24, 1983.

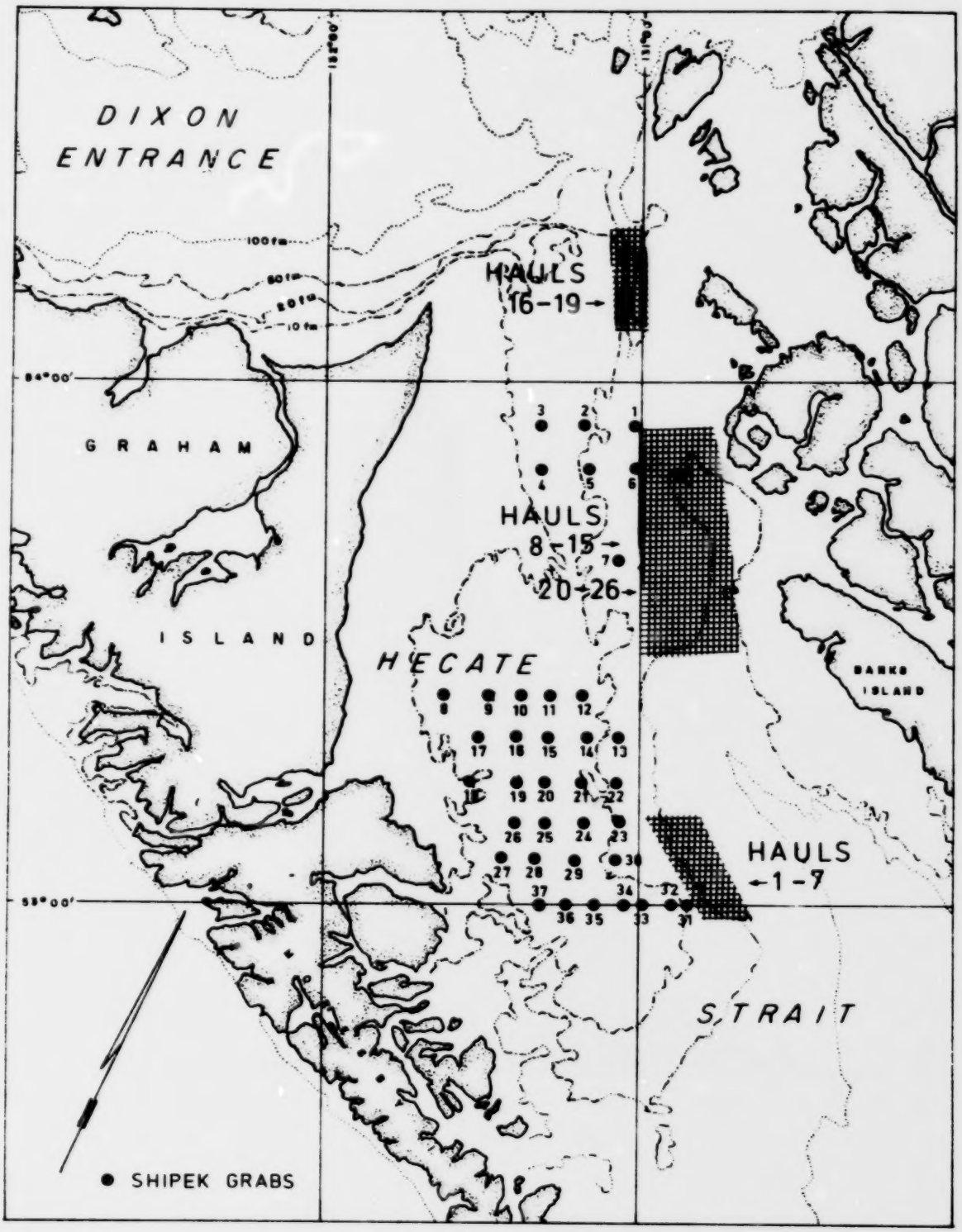


Fig. 3. Tagging locations and Shipek bottom grab tracklines for R/V G.B. REED English sole tagging cruise, June 6-24, 1983.

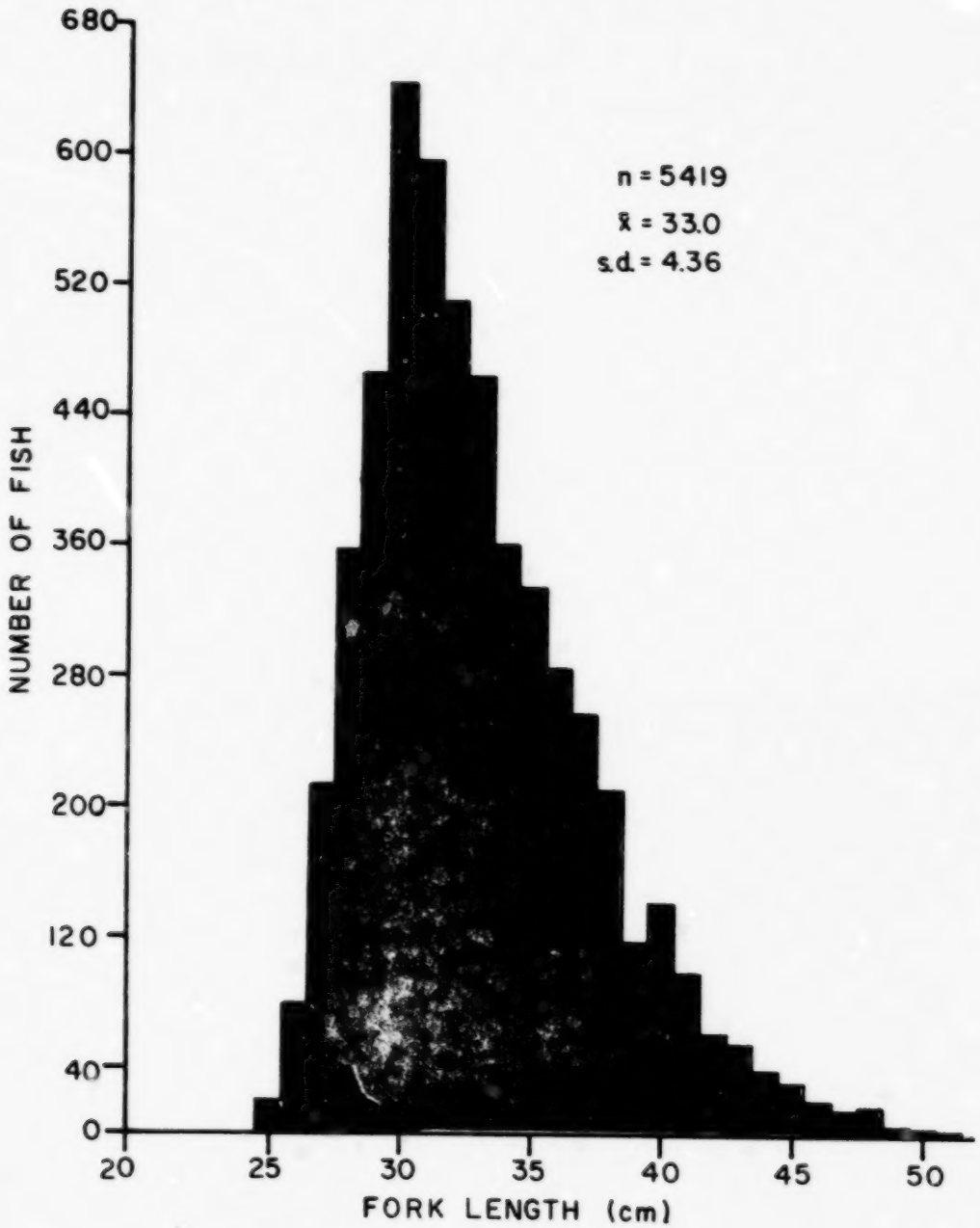


Fig. 4. Length frequency of all tagged English sole, R/V G.B. REED, June 6-24, 1983.

Fig. 5. English sole males length-weight relationship derived from White Rocks locality, R/V G.B. REED, June 6-24, 1983.

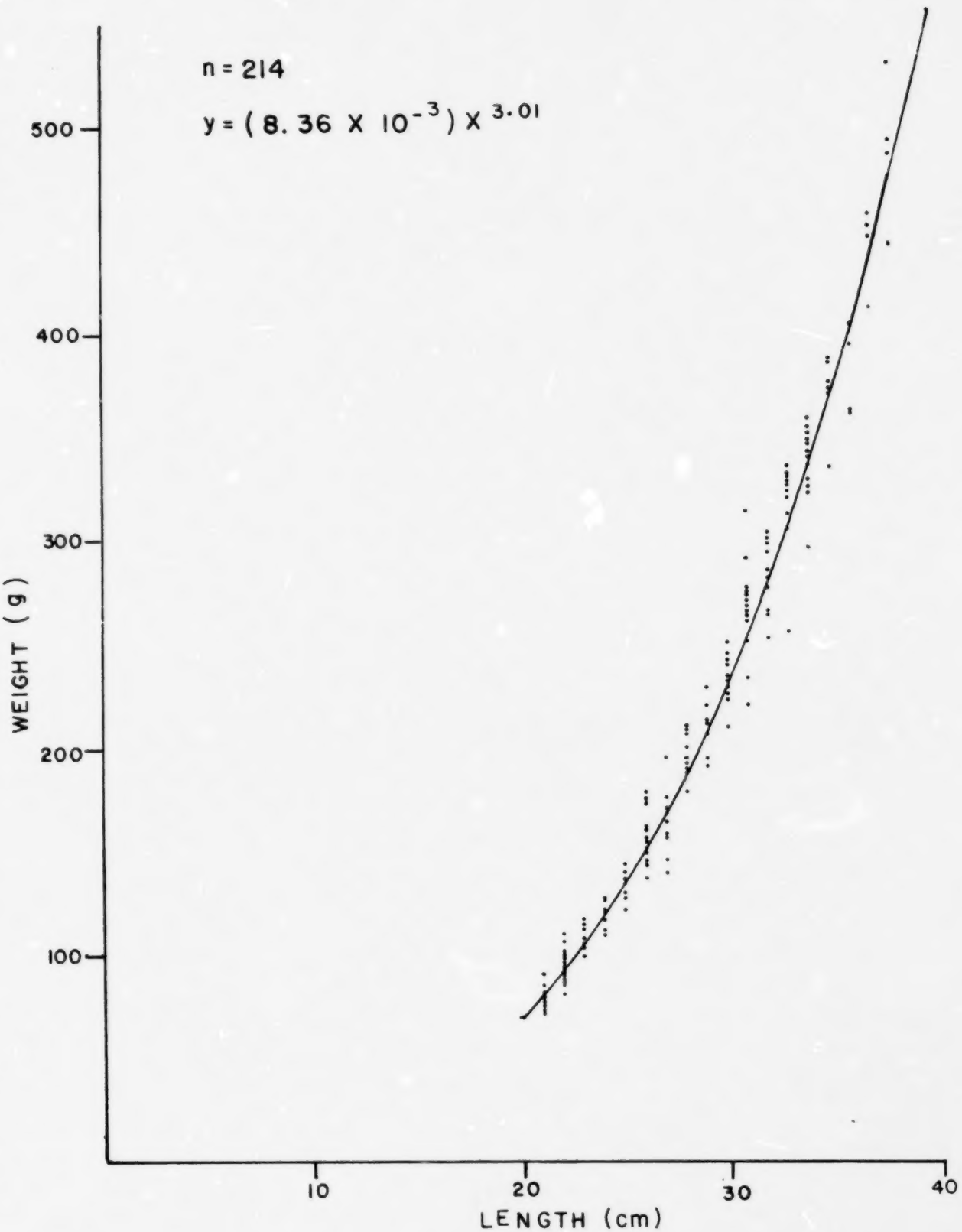
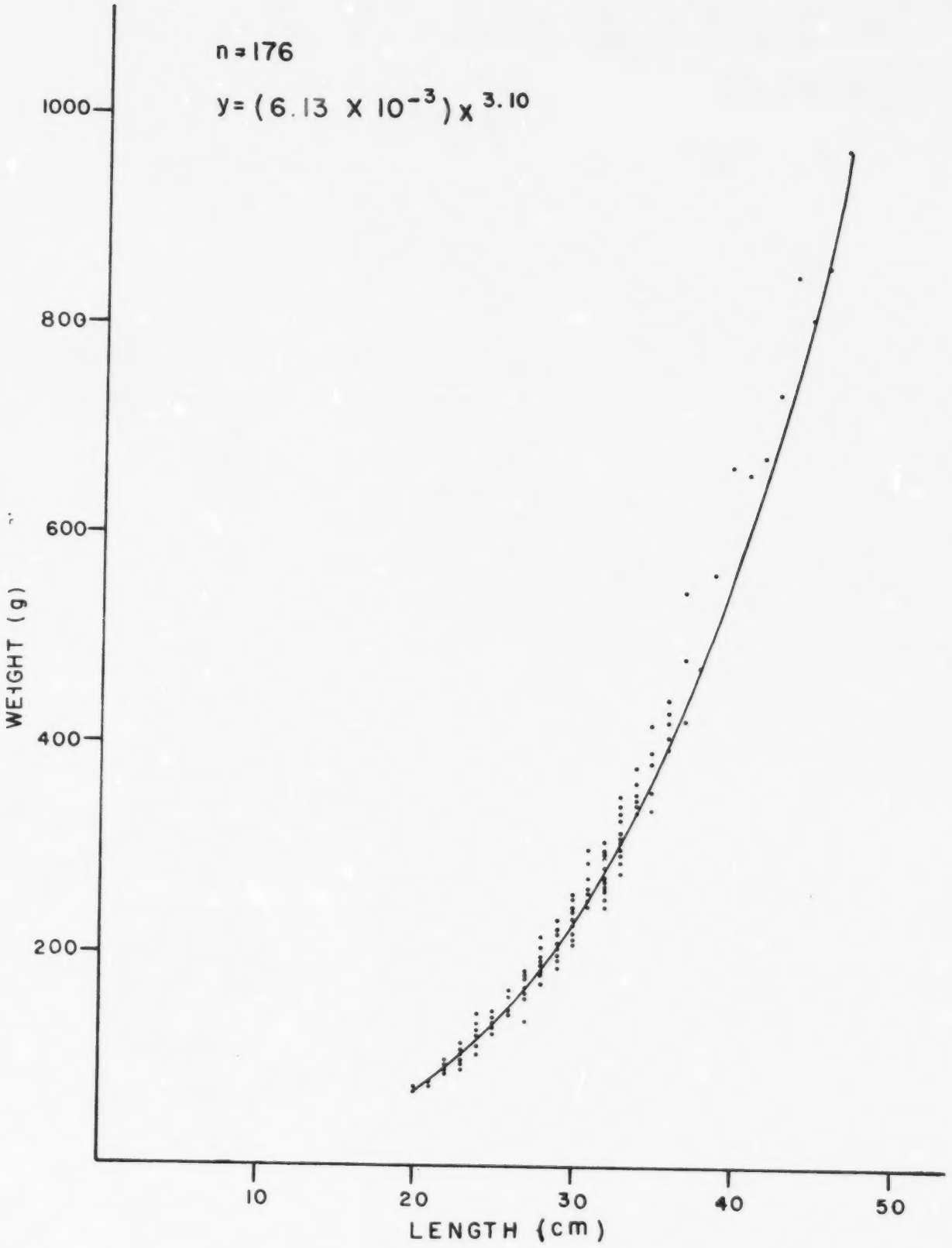

n = 214
y = (8.36 X 10⁻³) X 3.01
500
400
300
200
100
WEIGHT (g)
10
20
30
40
LENGTH (cm)

Fig. 6. English sole females length-weight relationship derived from White Rocks locality, R/V G.B. REED, June 6-24, 1983.


n = 176
y = (6.13 X 10⁻³) x 3.10
1000
800
600
400
200
WEIGHT (g)
10
20
30
40
50
LENGTH (cm)

Appendix Table 1. Bridge log data, R/V G.B. REED, Hecate Strait English sole tagging, June 6-24,1983.

HAUL NO.	1		2	
MAJOR AREA	5C		5C	
MINOR AREA	2B EAST		2B EAST	
DATE	JUNE 09		JUNE 09	
DEPTH MODE F/(M)	51 /(93)		52 /(95)	
DURATION (H)	0.33		0.33	
	START	STOP	START	STOP
TIME	12:42	13:02	15:08	15:28
LAT.(DEG,MIN)	53 00.5	52 59.7	53 00.5	52 59.7
LONG.(DEG,MIN)	130 47.6	130 46.5	130 47.4	130 46
LC-5990-X	12303	12311	12304	12314
LC-5990-Z	30419	30417	30419	30417
DEPTH (F)	51	50	51	52
SPECIES CATCH(KG.)				
BUTTER SOLE	-		-	
DAB (PACIFIC)	9		27	
DAB (SPECKLED)	-		-	
DOVER SOLE	-		-	
ENGLISH SOLE	109		191	
FLATHEAD SOLE	-		27	
HALIBUT	7		-	
PETRALE SOLE	4		-	
REX SOLE	5		27	
ROCK SOLE	-		-	
TURBOT	-		TRACE	
S. ALEUTIANUS	-		-	
S. ALUTUS	-		-	
S. BREVISPINIS	-		-	
S. MALIGER	-		-	
S. PAUCISPINIS	-		-	
S. PINNIGER	-		-	
S. RUBERRIMUS	-		-	
HERRING	-		-	
LINGCOD	TRACE		-	
PACIFIC COD	9		-	
PACIFIC TOMCOD	-		-	
SABLEFISH	-		-	
WALLEYE POLLOCK	-		TRACE	
DOGFISH	TRACE		TRACE	
RATFISH	TRACE		TRACE	
SKATES	-		-	
INVERTEBRATES	-		-	
TOTAL CATCH (KG.)	143		272	
REMARKS	USABLE		USABLE	

Appendix Table 1. Bridge log data, R/V G.B. REED, Hecate Strait English sole tagging, June 6-24,1983.

HAUL NO.	3		4	
MAJOR AREA	5C		5C	
MINOR AREA	2B EAST		2B EAST	
DATE	JUNE 10		JUNE 10	
DEPTH MODE F/(M)	51 /(93)		51 /(93)	
DURATION (H)	0.30		0.33	
	START	STOP	START	STOP
TIME	8:25	8:43	10:10	10:30
LAT.(DEG,MIN)	53 00.6	52 59.8	53 02.2	53 01.3
LONG.(DEG,MIN)	130 46.8	130 45.9	130 48.5	130 48
LC-5990-X	12305	12323	12286	12294
LC-5990-Z	30419	30418	30423	30421
DEPTH (F)	51	51	52	50
SPECIES CATCH(KG.)				
BUTTER SOLE	-		-	
DAB (PACIFIC)	9		TRACE	
DAB (SPECKLED)	-		-	
DOVER SOLE	TRACE		-	
ENGLISH SOLE	91		95	
FLATHEAD SOLE	TRACE		-	
HALIBUT	15		4	
PETRALE SOLE	TRACE		TRACE	
REX SOLE	36		48	
ROCK SOLE	-		-	
TURBOT	TRACE		-	
S. ALEUTIANUS	-		-	
S. ALUTUS	-		-	
S. BREVISPINIS	-		-	
S. MALIGER	-		-	
S. PAUCISPINIS	-		-	
S. PINNIGER	-		-	
S. RUBERRIMUS	-		-	
HERRING	-		-	
LINGCOD	9		TRACE	
PACIFIC COD	9		TRACE	
PACIFIC TOMCOD	-		-	
SABLEFISH	-		-	
WALLEYE POLLOCK	-		-	
DOGFISH	9		16	
RATFISH	TRACE		TRACE	
SKATES	TRACE		-	
INVERTEBRATES	-		TRACE	
TOTAL CATCH (KG.)	178		163	
REMARKS	USABLE		USABLE	

Appendix Table 1. Bridge log data, R/V G.B. REED, Hecate Strait English sole tagging, June 6-24,1983.

HAUL NO.	5		6	
MAJOR AREA	5C		5C	
MINOR AREA	2B EAST		2B EAST	
DATE	JUNE 10		JUNE 10	
DEPTH MODE F/(M)	53 /(96)		53 /(96)	
DURATION (H)	0.33		0.50	
	START	STOP	START	STOP
TIME	12:46	13:06	14:05	14:35
LAT.(DEG,MIN)	53 06.9	53 06.1	53 08.9	53 07.5
LONG.(DEG,MIN)	130 53.1	130 52.7	130 54.3	130 53.9
LC-5990-X	12234.2	12241.4	12214.5	12226.5
LC-5990-Z	30433	30430.5	30436.5	30432.5
DEPTH (F)	53	52	53	52
SPECIES CATCH(KG.)				
BUTTER SOLE	-		-	
DAB (PACIFIC)	-		14	
DAB (SPECKLED)	-		-	
DOVER SOLE	-		-	
ENGLISH SOLE	45		82	
FLATHEAD SOLE	-		-	
HALIBUT	23		47	
PETRALE SOLE	TRACE		-	
REX SOLE	TRACE		14	
ROCK SOLE	TRACE		27	
TURBOT	-		-	
S. ALEUTIANUS	-		-	
S. ALUTUS	-		-	
S. BREVISPINIS	-		-	
S. MALIGER	-		-	
S. PAUCISPINIS	-		-	
S. PINNIGER	-		-	
S. RUBERRIMUS	-		-	
HERRING	-		-	
LINGCOD	-		-	
PACIFIC COD	132		-	
PACIFIC TOMCOD	-		-	
SABLEFISH	TRACE		-	
WALLEYE POLLOCK	-		TRACE	
DOGFISH	27		82	
RATFISH	TRACE		TRACE	
SKATES	-		TRACE	
INVERTEBRATES	-		-	
TOTAL CATCH (KG.)	227		266	
REMARKS	USABLE		USABLE	

Appendix Table 1. Bridge log data, R/V G.B. REED, Hecate Strait English sole tagging, June 6-24,1983.

HAUL NO.	7		8	
MAJOR AREA	5C		5D	
MINOR AREA	2B EAST		5 UPPER	
DATE	JUNE 10		JUNE 11	
DEPTH MODE F/(M)	53 /(96)		49 /(89)	
DURATION (H)	0.47		0.50	
	START	STOP	START	STOP
TIME	15:31	15:59	8:57	9:27
LAT.(DEG,MIN)	53 09.4	53 08.3	53 30.6	53 29.6
LONG.(DEG,MIN)	130 54.3	130 54	130 52.4	130 54.1
LC-5990-X	12210.5	12208.5	12022.5	12063.5
LC-5990-Z	30437.5	30434	30504.5	30487.5
DEPTH (F)	54	51	48	50
SPECIES CATCH(KG.)				
BUTTER SOLE	-		-	
DAB (PACIFIC)	-		23	
DAB (SPECKLED)	-		-	
DOVER SOLE	-		-	
ENGLISH SOLE	45		364	
FLATHEAD SOLE	-		-	
HALIBUT	9		13	
PETRALE SOLE	-		-	
REX SOLE	-		46	
ROCK SOLE	45		23	
TURBOT	-		-	
S. ALEUTIANUS	-		-	
S. ALUTUS	-		-	
S. BREVISPINIS	-		-	
S. MALIGER	TRACE		-	
S. PAUCISPINIS	-		-	
S. PINNIGER	-		-	
S. RUBERRIMUS	TRACE		-	
HERRING	-		-	
LINGCOD	11		-	
PACIFIC COD	11		-	
PACIFIC TOMCOD	-		-	
SABLEFISH	-		TRACE	
WALLEYE POLLOCK	TRACE		-	
DOGFISH	68		TRACE	
RATFISH	TRACE		TRACE	
SKATES	-		-	
INVERTEBRATES	TRACE		-	
TOTAL CATCH (KG.)	189		469	
REMARKS	USABLE		USABLE	

Appendix Table 1. Bridge log data, R/V G.B. REED, Hecate Strait English sole tagging, June 6-24,1983.

HAUL NO.	9		10	
MAJOR AREA	5D		5D	
MINOR AREA	5 UPPER		5 UPPER	
DATE	JUNE 11		JUNE 12	
DEPTH MODE F/(M)	52 /(95)		47 /(85)	
DURATION (H)	0.50		0.33	
	START	STOP	START	STOP
TIME	13:26	13:56	8:27	8:47
LAT.(DEG,MIN)	53 30.3	53 29.3	53 41.2	53 40.2
LONG.(DEG,MIN)	130 52.4	130 54.7	130 46.7	130 46.5
LC-5990-X	12067	12065	12004	12012.5
LC-5990-Z	30491.3	30487	30520.5	30518.5
DEPTH (F)	52	52	45	48
SPECIES CATCH(KG.)				
BUTTER SOLE	-		-	
DAB (PACIFIC)	-		TRACE	
DAB (SPECKLED)	-		-	
DOVER SOLE	-		-	
ENGLISH SOLE	232		228	
FLATHEAD SOLE	-		-	
HALIBUT	6		37	
PETRALE SOLE	19		-	
REX SOLE	8		46	
ROCK SOLE	19		-	
TURBOT	-		TRACE	
S. ALEUTIANUS	-		-	
S. ALUTUS	-		TRACE	
S. BREVISPINIS	-		-	
S. MALIGER	-		-	
S. PAUCISPINIS	-		TRACE	
S. PINNIGER	-		-	
S. RUBERRIMUS	-		-	
HERRING	-		-	
LINGCOD	-		-	
PACIFIC COD	39		46	
PACIFIC TOMCOD	-		-	
SABLEFISH	TRACE		TRACE	
WALLEYE POLLOCK	-		-	
DOGFISH	58		68	
RATFISH	-		23	
SKATES	TRACE		-	
INVERTEBRATES	-		-	
TOTAL CATCH (KG.)	381		448	
REMARKS	USABLE		USABLE	

Appendix Table 1. Bridge log data, R/V G.B. REED, Hecate Strait English sole tagging, June 6-24,1983.

HAUL NO.	11		12	
MAJOR AREA	5D		5D	
MINOR AREA	5 UPPER		5 UPPER	
DATE	JUNE 12		JUNE 12	
DEPTH MODE F/(M)	54 /(98)		47 /(85)	
DURATION (H)	0.33		0.33	
	START	STOP	START	STOP
TIME	12:03	12:23	13:48	14:08
LAT.(DEG,MIN)	53 41	53 42.3	53 41.8	53 41
LONG.(DEG,MIN)	130 46.6	130 46.9	130 47.4	130 46.4
LC-5990-X	12008	11997.5	11996	12012
LC-5990-Z	30520	30522.5	30521.5	30520.3
DEPTH (F)	48	60	44	50
SPECIES CATCH(KG.)				
BUTTER SOLE	-		TRACE	
DAB (PACIFIC)	-		TRACE	
DAB (SPECKLED)	-		-	
DOVER SOLE	TRACE		-	
ENGLISH SOLE	127		102	
FLATHEAD SOLE	-		-	
HALIBUT	5		271	
PETRALE SOLE	TRACE		TRACE	
REX SOLE	16		-	
ROCK SOLE	-		TRACE	
TURBOT	32		17	
S. ALEUTIANUS	-		-	
S. ALUTUS	-		-	
S. BREVISPINIS	TRACE		-	
S. MALIGER	-		-	
S. PAUCISPINIS	TRACE		17	
S. PINNIGER	TRACE		-	
S. RUBERRIMUS	-		-	
HERRING	-		-	
LINGCOD	-		-	
PACIFIC COD	TRACE		17	
PACIFIC TOMCOD	-		-	
SABLEFISH	TRACE		TRACE	
WALLEYE POLLOCK	32		TRACE	
DOGFISH	64		-	
RATFISH	16		TRACE	
SKATES	16		17	
INVERTEBRATES	-		-	
TOTAL CATCH (KG.)	308		441	
REMARKS	USABLE		USABLE	

Appendix Table 1. Bridge log data, R/V G.B. REED, Hecate Strait English sole tagging, June 6-24,1983.

HAUL NO.	13		14	
MAJOR AREA	5D		5D	
MINOR AREA	5 UPPER		5 UPPER	
DATE	JUNE 12		JUNE 13	
DEPTH MODE F/(M)	52 /(95)		33 /(60)	
DURATION (H)	0.33		0.33	
TIME	START 14:55	STOP 15:15	START 8:30	STOP 8:50
LAT. (DEG,MIN)	53 41	53 40.1	53 52	54 00
LONG. (DEG,MIN)	130 46.2	130 46.5	131 00.3	131 00.6
LC-5990-X	12012	12014	11864.5	11800
LC-5990-Z	30520.3	30520.4	30534	30550.5
DEPTH (F)	52	51	29	37
SPECIES CATCH(KG.)				
BUTTER SOLE	-		-	
DAB (PACIFIC)	-		-	
DAB (SPECKLED)	-		-	
DOVER SOLE	-		-	
ENGLISH SOLE	75		TRACE	
FLATHEAD SOLE	-		-	
HALIBUT	12		225	
PETRALE SOLE	-		-	
REX SOLE	-		-	
ROCK SOLE	-		91	
TURBOT	75		-	
S. ALEUTIANUS	-		-	
S. ALUTUS	-		-	
S. BREVISPINIS	-		-	
S. MALIGER	-		-	
S. PAUCISPINIS	TRACE		-	
S. PINNIGER	-		-	
S. RUBERRIMUS	-		-	
HERRING	-		-	
LINGCOD	-		-	
PACIFIC COD	TRACE		91	
PACIFIC TOMCOD	-		-	
SABLEFISH	-		91	
WALLEYE POLLOCK	13		-	
DOGFISH	75		45	
RATFISH	-		45	
SKATES	-		-	
INVERTEBRATES	-		TRACE	
TOTAL CATCH (KG.)	250		588	
REMARKS	USABLE		USABLE	

Appendix Table 1. Bridge log data, R/V G.B. REED, Hecate Strait English sole tagging, June 6-24,1983.

HAUL NO.	15		16	
MAJOR AREA	5D		5D	
MINOR AREA	5 UPPER		4	
DATE	JUNE 13		JUNE 15	
DEPTH MODE F/(M)	52 /(95)		47 /(85)	
DURATION (H)	0.33		0.50	
	START	STOP	START	STOP
TIME	10:23	10:43	8:21	8:51
LAT.(DEG,MIN)	53 50.4	53 51.3	54 15.7	54 14.7
LONG.(DEG,MIN)	130 56.3	130 57.1	131 04.2	131 03.6
LC-5990-X	11893.5	11882.5	11658	11668.5
LC-5990-Z	30533.5	30535	30579.2	30578
DEPTH (F)	50	54	43	50
SPECIES CATCH(KG.)				
BUTTER SOLE	-		TRACE	
DAB (PACIFIC)	-		-	
DAB (SPECKLED)	-		-	
DOVER SOLE	TRACE		-	
ENGLISH SOLE	18		409	
FLATHEAD SOLE	-		-	
HALIBUT	27		41	
PETRALE SOLE	TRACE		-	
REX SOLE	TRACE		5	
ROCK SOLE	-		TRACE	
TURBOT	91		409	
S. ALEUTIANUS	-		-	
S. ALUTUS	-		-	
S. BREVISPINIS	-		-	
S. MALIGER	-		-	
S. PAUCISPINIS	-		-	
S. PINNIGER	-		-	
S. RUBERRIMUS	-		TRACE	
HERRING	-		-	
LINGCOD	-		TRACE	
PACIFIC COD	9		TRACE	
PACIFIC TOMCOD	-		TRACE	
SABLEFISH	-		-	
WALLEYE POLLOCK	18		TRACE	
DOGFISH	18		136	
RATFISH	18		TRACE	
SKATES	-		TRACE	
INVERTEBRATES	-		205	
TOTAL CATCH (KG.)	199		1205	
REMARKS	USABLE		USABLE	

Appendix Table 1. Bridge log data, R/V G.B. REED, Hecate Strait English sole tagging, June 6-24,1983.

HAUL NO.	17		18	
MAJOR AREA	5D		5D	
MINOR AREA	4		4	
DATE	JUNE 15		JUNE 15	
DEPTH MODE F/(M)	55 /(100)		56 /(102)	
DURATION (H)	0.25		0.25	
	START	STOP	START	STOP
TIME	10:40	10:55	13:20	13:35
LAT.(DEG,MIN)	54 13	54 12.3	54 11.3	54 10.5
LONG.(DEG,MIN)	131 03.5	131 03.4	131 03.8	131 04.3
LC-5990-X	11682.5	11689	11695	11700
LC-5990-Z	30574.5	30573.5	30571.5	30569.5
DEPTH (F)	55	55	56	55
SPECIES CATCH(KG.)				
BUTTER SOLE	-		-	
DAB (PACIFIC)	-		-	
DAB (SPECKLED)	-		-	
DOVER SOLE	18		91	
ENGLISH SOLE	55		TRACE	
FLATHEAD SOLE	TRACE		TRACE	
HALIBUT	22		20	
PETRALE SOLE	-		-	
REX SOLE	18		46	
ROCK SOLE	-		-	
TURBOT	18		228	
S. ALEUTIANUS	-		TRACE	
S. ALUTUS	-		-	
S. BREVISPINIS	-		TRACE	
S. MALIGER	-		-	
S. PAUCISPINIS	-		-	
S. PINNIGER	-		-	
S. RUBERRIMUS	-		-	
HERRING	-		-	
LINGCOD	TRACE		-	
PACIFIC COD	9		TRACE	
PACIFIC TOMCOD	-		-	
SABLEFISH	-		-	
WALLEYE POLLOCK	-		23	
DOGFISH	9		68	
RATFISH	9		TRACE	
SKATES	36		-	
INVERTEBRATES	TRACE		-	
TOTAL CATCH (KG.)	194		476	
REMARKS	USABLE		USABLE	

Appendix Table 1. Bridge log data, R/V G.B. REED, Hecate Strait English sole tagging, June 6-24,1983.

HAUL NO.	19		20	
MAJOR AREA	5D		5D	
MINOR AREA	4		5 UPPER	
DATE	JUNE 15		JUNE 17	
DEPTH MODE F/(M)	48 /(87)		50 /(91)	
DURATION (H)	0.25		0.33	
	START	STOP	START	STOP
TIME	14:30	14:45	8:32	8:52
LAT.(DEG,MIN)	54 08.9	54 08	53 45	53 44.2
LONG.(DEG,MIN)	131 04.5	131 04.8	130 51.1	130 49.9
LC-5990-X	11712	11719	11957	11968
LC-5990-Z	30565.5	30564	30525	30524
DEPTH (F)	52	44	52	48
SPECIES CATCH(KG.)				
BUTTER SOLE	-		-	
DAB (PACIFIC)	-		-	
DAB (SPECKLED)	-		-	
DOVER SOLE	TRACE		TRACE	
ENGLISH SOLE	9		68	
FLATHEAD SOLE	TRACE		-	
HALIBUT	59		55	
PETRALE SOLE	-		-	
REX SOLE	9		11	
ROCK SOLE	-		-	
TURBOT	109		45	
S. ALEUTIANUS	-		-	
S. ALUTUS	-		-	
S. BREVISPINIS	TRACE		-	
S. MALIGER	-		-	
S. PAUCISPINIS	-		-	
S. PINNIGER	-		-	
S. RUBERRIMUS	-		-	
HERRING	-		TRACE	
LINGCOD	TRACE		-	
PACIFIC COD	TRACE		TRACE	
PACIFIC TOMCOD	TRACE		-	
SABLEFISH	TRACE		-	
WALLEYE POLLOCK	27		34	
DOGFISH	9		23	
RATFISH	TRACE		23	
SKATES	TRACE		TRACE	
INVERTEBRATES	-		TRACE	
TOTAL CATCH (KG.)	222		259	
REMARKS	USABLE		USABLE	

Appendix Table 1. Bridge log data, R/V G.B. REED, Hecate Strait English sole tagging, June 6-24,1983.

HAUL NO.	21		22	
MAJOR AREA	5D		5D	
MINOR AREA	5 UPPER		5 UPPER	
DATE	JUNE 17		JUNE 17	
DEPTH MODE F/(M)	51 /(93)		54 /(98)	
DURATION (H)	0.33		0.33	
TIME	START	STOP	START	STOP
LAT.(DEG,MIN)	9:37	9:57	12:13	12:33
LONG.(DEG,MIN)	53 44.4	53 43.7	53 44.2	53 43.4
LC-5990-X	130 50.1	130 48.7	130 49.4	130 48
LC-5990-Z	11964.5	11977	11970	11982.5
DEPTH (F)	30524.5	30524	30525	30524
	51	51	53	54
SPECIES CATCH(KG.)				
BUTTER SOLE	-		-	
DAB (PACIFIC)	-		-	
DAB (SPECKLED)	-		-	
DOVER SOLE	-		TRACE	
ENGLISH SOLE	89		55	
FLATHEAD SOLE	-		-	
HALIBUT	34		41	
PETRALE SOLE	TRACE		TRACE	
REX SOLE	TRACE		TRACE	
ROCK SOLE	-		-	
TURBOT	148		109	
S. ALEUTIANUS	-		-	
S. ALUTUS	-		-	
S. BREVISPINIS	TRACE		-	
S. MALIGER	-		-	
S. PAUCISPINIS	-		-	
S. PINNIGER	-		-	
S. RUBERRIMUS	TRACE		-	
HERRING	-		-	
LINGCOD	-		-	
PACIFIC COD	TRACE		27	
PACIFIC TOMCOD	-		-	
SABLEFISH	TRACE		TRACE	
WALLEYE POLLOCK	30		27	
DOGFISH	30		27	
RATFISH	TRACE		TRACE	
SKATES	-		TRACE	
INVERTEBRATES	-		-	
TOTAL CATCH (KG.)	331		286	
REMARKS	USABLE		USABLE	

Appendix Table 1. Bridge log data, R/V G.B. REED, Hecate Strait English sole tagging, June 6-24,1983.

HAUL NO.	23		24	
MAJOR AREA	5D		5D	
MINOR AREA	5 UPPER		5 UPPER	
DATE	JUNE 17		JUNE 17	
DEPTH MODE F/(M)	56 /(102)		49 /(89)	
DURATION (H)	0.33		0.33	
TIME	START 13:35	STOP 13:55	START 15:55	STOP 16:15
LAT.(DEG,MIN)	53 40.7	53 39.7	53 41.3	53 40.6
LONG.(DEG,MIN)	130 46	130 46.5	130 46.5	130 46.4
LC-5990-X	12012	12015.5	12014.5	12010
LC-5990-Z	30518.5	30516	30520	30518
DEPTH (F)	58	54	48	50
SPECIES CATCH(KG.)				
BUTTER SOLE	-		-	
DAB (PACIFIC)	-		-	
DAB (SPECKLED)	-		-	
DOVER SOLE	-		TRACE	
ENGLISH SOLE	445		223	
FLATHEAD SOLE	-		-	
HALIBUT	30		28	
PETRALE SOLE	TRACE		TRACE	
REX SOLE	TRACE		TRACE	
ROCK SOLE	-		-	
TURBOT	64		16	
S. ALEUTIANUS	-		-	
S. ALUTUS	-		-	
S. BREVISPINIS	-		-	
S. MALIGER	-		-	
S. PAUCISPINIS	-		TRACE	
S. PINNIGER	-		-	
S. RUBERRIMUS	-		-	
HERRING	-		-	
LINGCOD	-		-	
PACIFIC COD	TRACE		16	
PACIFIC TOMCOD	-		-	
SABLEFISH	TRACE		TRACE	
WALLEYE POLLOCK	64		16	
DOGFISH	32		32	
RATFISH	TRACE		TRACE	
SKATES	-		TRACE	
INVERTEBRATES	-		-	
TOTAL CATCH (KG.)	635		331	
REMARKS	USABLE		USABLE	

Appendix Table 1. Bridge log data, R/V G.B. REED, Hecate Strait English sole tagging, June 6-24,1983.

HAUL NO.	25	26
MAJOR AREA	5D	5D
MINOR AREA	5 UPPER	5 UPPER
DATE	JUNE 18	JUNE 18
DEPTH MODE F/(M)	50 /(91)	49 /(89)
DURATION (H)	0.33	0.42
TIME	START 8:22 / STOP 8:42	START 10:38 / STOP 11:03
LAT.(DEG,MIN)	53 29.3 / 53 29.7	53 38 / 53 39.3
LONG.(DEG,MIN)	130 55.2 / 130 53.4	130 47.2 / 130 46.8
LC-5990-X	12480.5 / 12485	12455 / 12447.5
LC-5990-Z	30322 / 30324	30352.5 / 30357
DEPTH (F)	50 / 50	46 / 52
SPECIES CATCH(KG.)		
BUTTER SOLE	-	-
DAB (PACIFIC)	-	-
DAB (SPECKLED)	23	-
DOVER SOLE	-	TRACE
ENGLISH SOLE	136	546
FLATHEAD SOLE	-	-
HALIBUT	17	29
PETRALE SOLE	TRACE	TRACE
REX SOLE	11	68
ROCK SOLE	TRACE	-
TURBOT	11	409
S. ALEUTIANUS	-	-
S. ALUTUS	-	-
S. BREVISPINIS	-	-
S. MALIGER	-	-
S. PAUCISPINIS	-	68
S. PINNIGER	-	-
S. RUBERRIMUS	-	-
HERRING	-	TRACE
LINGCOD	-	TRACE
PACIFIC COD	TRACE	TRACE
PACIFIC TOMCOD	-	-
SABLEFISH	11	TRACE
WALLEYE POLLOCK	-	68
DOGFISH	TRACE	136
RATFISH	11	68
SKATES	11	-
INVERTEBRATES	-	-
TOTAL CATCH (KG.)	231	1392
REMARKS	USABLE	USABLE

Appendix table 2. Common and scientific names of fish species caught, R/V G.B. REED, June 6-24, 1983.

Common name	Scientific name
Flatfish	
Butter sole	Isopsetta isolepis
Dover sole	Microstomus pacificus
English sole	Parophrys vetulus
Flathead sole	Hippoglossoides elassodon
Pacific halibut	Hippoglossus stenolepis
Pacific sanddab	Citharichthys sordidus
Petrale sole	Eopsetta jordani
Rex sole	Glyptocephalus zachirus
Rock sole	Lepidopsetta bilineata
Speckled sanddab	Citharichthys stigmaeus
Turbot	Atheresthes stomias
Rockfish	
Rougheye rockfish	Sebastes aleutianus
Pacific ocean perch	Sebastes alutus
Silvergray rockfish	Sebastes brevispinis
Quillback rockfish	Sebastes maliger
Bocaccio	Sebastes paucispinis
Canary rockfish	Sebastes pinniger
Yelloweye rockfish	Sebastes ruberrimus
Roundfish	
Blackcod	Anoplopoma fimbria
Lingcod	Ophiodon elongatus
Pacific cod	Gadus macrocephalus
Pacific herring	Clupea harengus pallasi
Pacific pollock	Theragra chalcogramma
Tomcod	Microgadus proximus
Selachii	
Big skate	Raja binoculata
Ratfish	Hydrolagus colliei
Spiny dogfish	Squalus acanthias

Appendix table 3.

Date	Haul no.	Tag number[a] F82-	No. released	Broken tags[a]	Dead in recovery tank: No.	Dead in recovery tank: % of no. tagged[b]
June						
9	1	039225-039392 039400-039414	169	13	1	1
9	2	039393-039399 039415-039539	142	6	0	0
10	3	039559-039574 039540-039558 039575-039695, 039700	138	2	1	1
10	4	039696-039699 039701-039839	134	9	0	0
10	5	039840-039895 039900-039904	57	4	0	0
10	6	039896-039899 039905-040057	156	5	0	0
10	7	040075-040078 040058-040074 040079-040098	38	2	0	0
11	8	040150-040152 040099-040149 040153-040722	595	23	3	1
11	9	040723-041322	576	21	3	1
12	10	041323-041780 041800-041806	449	13	3	1
12	11	041781-041799 041807-041949	162	8	0	0
12	12	041967-041974 041950-041966 041975-041999	236	1	0	0
12	13[c]	97000-97193 97194-97372 97375-97383	178	11	0	0
13	15	97373-97374 97384-97490	106	3	0	0
15	16	97491-97568 97575-97599	58	3	42	42
15	17	97569-97574 97600-97741	142	3	3	2
15	18	97742-97757	15	1	0	0
15	19	97758-97808 97825-97845 97850-97874	86	11	0	0
17	20	97809-97824 97846-97849 97875-98048 98050-98060	203	2	0	0

Appendix table 3.

Date	Haul no.	Tag number[a] F82-	No. released	Broken tags[a]	Dead in recovery tank: No.	Dead in recovery tank: % of no. tagged[b]
17	21	98049 98061-98266 98275-98283	214	2	0	0
17	22	98267-98274 98284-98393 98400-98414	132	1	0	0
17	23	98394-98399 98415-98999 99000-99145 99150-99177	756	8	1	0
17	24	99146-99149 99178-99508 99525-99531	334	8	0	0
18	25	99509-99524 99532-99819	300	4	0	0
Total			5376	164	57	1

[a]includes broken tags and tags removed from dead fish (broken tags were replaced).

[b]no. tagged is total of no. released and no. dead after tagging.

[c]two no. 97221 in series

Appendix table 4. Summary of English sole tagged by haul, R/V G.B. REED, June 6-24, 1983.

Fork length (cm)	Haul																								
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
24	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	-	-	-	-	-	-	1	2	2	-	-	-	-	-	1	-	-	-	-	3	5	1	5	-	1
6	4	3	-	2	-	-	0	1	3	2	-	3	2	-	1	-	-	-	2	5	10	8	25	6	3
7	6	10	-	0	2	7	0	2	14	18	4	8	2	-	5	-	-	-	7	18	17	9	43	15	26
8	8	2	-	3	3	7	2	16	22	37	3	12	9	-	3	3	-	-	7	19	18	20	95	40	29
9	8	8	3	6	4	15	5	30	54	45	11	14	11	-	4	1	2	1	3	27	21	14	100	46	33
30	6	18	10	7	9	12	5	54	98	77	15	17	20	-	8	2	1	1	13	28	33	15	114	42	39
1	12	13	7	9	4	18	3	72	80	61	21	24	19	-	4	11	3	0	6	18	26	18	105	36	27
2	9	6	11	13	5	18	3	76	60	39	13	18	35	-	8	10	7	0	8	18	24	9	66	31	24
3	14	13	15	12	4	12	2	67	62	35	14	18	19	-	8	14	3	0	7	13	12	7	62	22	29
4	9	7	11	6	5	13	5	56	43	25	11	16	16	-	7	16	10	1	8	6	10	7	41	17	17
5	18	11	6	13	6	10	1	55	40	20	9	12	13	-	6	16	21	0	5	9	4	4	31	12	13
6	9	7	8	15	3	10	5	56	31	18	10	6	5	-	4	5	10	1	4	10	11	3	23	18	13
7	10	7	10	12	4	10	2	36	25	13	9	13	4	-	7	7	16	3	6	8	5	7	17	11	15
8	8	5	12	12	1	10	2	19	15	18	9	13	10	-	8	7	15	0	4	6	5	1	10	12	9
9	6	9	8	5	1	2	1	7	5	8	6	10	3	-	10	2	10	2	1	5	4	2	5	4	2
40	6	7	12	8	1	5	1	13	6	7	8	13	4	-	6	3	14	2	2	3	2	4	3	8	4
1	8	5	5	1	2	2	-	9	7	8	5	6	2	-	4	2	13	1	1	3	0	2	4	5	3
2	6	2	4	1	0	0	-	8	6	6	4	3	1	-	1	1	6	0	1	1	0	0	2	3	6
3	5	3	5	1	1	0	-	4	4	3	2	10	1	-	3	-	6	1	0	0	3	0	0	3	1
4	4	0	5	2	1	1	-	2	-	4	2	7	0	-	2	-	3	0	0	1	0	1	2	1	2
5	4	1	5	1	1	2	-	3	-	0	4	6	1	-	1	-	0	0	0	0	1	-	2	0	0
6	3	3	1	2	-	-	-	1	-	1	0	2	1	-	2	-	1	0	1	1	1	-	1	0	0
7	3	1	1	2	-	-	-	3	-	1	0	1	-	-	0	-	1	0	-	-	1	-	-	0	0
8	3	0	-	1	-	-	-	-	-	3	1	1	-	-	1	-	2	2	-	-	0	-	-	0	0
9	0	0	-	-	-	-	-	-	-	1	-	0	-	-	1	-	1	-	-	-	1	-	-	0	3
50	0	0	-	-	-	-	-	-	-	-	-	2	-	-	1	-	-	-	-	-	-	-	-	1	0
1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Total	170	142	139	134	57	156	38	593	577	450	161	235	178	0	106	100	145	15	86	202	214	132	756	333	300

Appendix table 5. English sole length-weight summaries from Hecate Strait.

	Butterworth 1979[a]				White Rocks 1983[b]			
	males		females		males		females	
	$\bar{W}$(g)	N	$\bar{W}$(g)	N	$\bar{W}$(g)	N	$\bar{W}$(g)	N
20	74.3	3	-	-	68.5	4	71.7	3
1	82.0	2	88.5	2	79.0	17	75.7	3
2	96.3	6	98.0	4	93.3	19	92.9	8
3	114.2	10	110.7	6	106.0	21	100.7	9
4	123.1	7	131.3	4	120.5	13	120.6	10
5	144.9	11	140.1	7	131.8	11	135.3	10
6	154.9	7	168.3	13	154.6	16	149.0	10
7	174.4	9	182.8	5	164.3	10	166.7	10
8	184.0	1	206.7	6	195.3	10	195.3	14
9	221.0	1	228.3	3	207.6	11	207.4	10
30	236.0	1	228.3	3	234.3	10	235.9	14
1	-	-	-	-	266.9	15	266.9	10
2	-	-	297.0	1	282.0	10	279.3	15
3	-	-	-	-	317.7	11	309.0	16
4	-	-	-	-	337.7	17	350.8	8
5	-	-	412.0	1	371.0	7	382.2	5
6	-	-	-	-	380.0	4	415.3	6
7	-	-	-	-	441.5	4	483.0	3
8	-	-	521.0	1	487.5	4	474.0	1
9	-	-	-	-	-	-	537.0	2
40	-	-	-	-	-	-	665.0	1
1	-	-	646.0	1	-	-	659.0	2
2	-	-	500.0	1	-	-	674.0	1
3	-	-	-	-	-	-	735.0	1
4	-	-	-	-	-	-	857.0	1
5	-	-	-	-	-	-	806.0	1
6	-	-	-	-	-	-	856.0	1
7	-	-	784.0	1	-	-	966.0	1
8	-	-	-	-	-	-	-	-
9	-	-	1059.5	2	-	-	-	-
50	-	-	1036.0	2	-	-	-	-
1	-	-	-	-	-	-	-	-
2	-	-	1220.0	1	-	-	-	-
3	-	-	1343.0	1	-	-	-	-
Total		58		65		214		176

[a]Sampled Sept/79 aboard M/V BLUE WATERS on Dover sole tagging charter (Stocker et al. 1979).

[b]Sampled June/83 aboard R/V G.B. REED on English sole tagging charter.

Appendix Table 6. Size composition (nos. sampled) of Pacific cod sampled in Hecate Strait, R/V G.B. REED, June 6-24, 1983.

Fork length (cm)	Haul																						
	1	2	3	4	5	6	7	9	10	11	12	13	14	15	17	18	19	20	21	22	24	25	26
25	-	-	-	-	-	-	1	-	-	-	1	-	13	-	-	-	-	-	-	-	-	-	-
6	-	-	-	1	-	-	1	1	-	-	0	-	18	-	-	-	-	-	-	-	-	-	-
7	-	-	1	1	-	-	0	0	-	-	2	-	39	-	-	-	-	-	-	-	-	-	1
8	-	2	2	0	-	-	3	0	-	-	1	-	59	-	-	-	-	-	-	-	-	-	8
9	3	1	0	0	-	-	9	0	1	-	3	-	50	-	-	-	-	-	-	-	-	-	6
30	2	4	1	0	1	-	12	1	1	-	2	1	55	-	-	-	-	-	-	-	-	-	6
1	3	2	7	2	0	-	11	7	2	-	1	0	32	-	-	-	1	-	-	-	-	-	11
2	4	3	5	1	0	1	8	1	0	-	0	1	35	-	-	-	2	-	-	2	1	2	15
3	3	4	3	1	1	0	3	1	0	-	2	0	15	-	-	-	0	-	-	2	0	1	10
4	1	1	6	1	0	0	5	2	0	-	5	1	15	-	-	-	1	-	-	0	1	0	7
5	1	2	0	-	1	0	2	0	2	2	0	1	5	-	-	-	1	-	-	1	0	0	10
6	0	1	0	-	0	0	0	0	0	0	3	0	4	1	-	-	0	-	-	0	0	0	8
7	2	1	2	-	0	0	0	0	2	0	3	0	5	0	-	1	0	-	-	1	0	0	3
8	-	-	0	-	0	0	0	1	0	0	0	0	1	1	1	1	0	-	-	0	0	0	1
9	-	-	0	-	0	0	0	0	1	0	0	0	1	0	0	0	0	-	-	0	0	0	2
40	-	-	0	-	0	0	0	0	0	0	1	1	2	0	1	0	0	-	-	0	0	0	1
1	-	-	0	-	0	0	0	0	0	0	1	0	0	0	0	0	0	-	-	0	0	0	0
2	-	-	0	-	0	0	0	0	0	0	0	0	0	0	1	0	0	-	-	0	0	0	0
3	-	-	0	-	0	0	0	0	1	0	0	0	0	0	0	0	0	-	-	0	0	0	0
4	-	-	0	-	0	0	0	1	0	0	0	0	0	0	0	1	0	-	-	0	0	0	0
5	-	-	0	-	0	0	0	0	0	0	0	0	0	0	0	1	1	-	-	0	0	0	0
6	-	-	0	-	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-	0	0	0	1
7	-	-	0	-	1	0	0	0	0	0	0	0	0	0	1	0	1	-	-	0	0	0	0
8	-	-	0	-	1	0	0	0	0	0	0	0	2	0	1	0	1	-	2	0	0	0	0
9	-	-	0	-	3	0	0	1	0	0	0	0	3	1	0	0	0	-	0	0	0	0	2
50	-	-	0	-	1	0	0	0	1	0	1	0	1	1	2	1	1	-	0	0	0	0	0
1	-	-	0	-	0	0	0	0	0	0	2	0	0	0	1	0	0	-	1	0	1	0	0
2	-	-	0	-	2	0	1	0	1	0	0	0	1	0	0	0	0	-	0	0	0	0	1
3	-	-	0	-	1	0	-	0	0	0	1	0	0	1	0	0	1	-	0	0	1	0	2
4	-	-	0	-	5	0	-	0	1	0	0	1	3	-	0	0	0	-	0	0	3	1	0
5	-	-	1	-	4	0	-	0	0	0	2	0	1	-	1	0	0	-	0	1	1	-	1

Appendix Table 6 (cont'd)

Fork length (cm)	Haul																						
	1	2	3	4	5	6	7	9	10	11	12	13	14	15	17	18	19	20	21	22	24	25	26
56	-	-	-	-	1	0	-	0	1	0	1	0	0	-	0	0	0	-	0	0	0	-	0
7	-	-	-	-	3	0	-	0	0	0	1	1	1	-	0	0	0	-	0	0	1	-	1
8	-	-	-	-	1	0	-	0	0	0	0	1	0	-	0	0	1	-	0	1	0	-	2
9	-	-	-	-	5	0	-	0	1	0	1	0	0	-	0	0	0	-	0	0	1	-	0
60	-	-	-	-	6	0	-	0	0	0	1	1	3	-	0	0	-	0	0	0	1	-	1
1	-	-	-	-	2	0	-	0	1	1	1	0	1	-	0	0	-	0	0	0	1	-	2
2	-	-	-	-	7	0	-	0	2	1	0	0	0	-	1	0	-	0	1	0	0	-	0
3	-	-	-	-	4	0	-	1	1	0	1	0	2	-	1	0	-	0	0	0	0	-	1
4	-	-	-	-	5	0	-	1	2	0	1	0	0	-	0	0	-	0	0	0	2	-	2
5	-	-	-	-	1	0	-	1	0	0	0	1	1	-	1	0	-	1	0	0	0	-	0
6	-	-	-	-	1	1	-	0	0	1	0	1	0	-	0	0	-	-	1	0	0	-	1
7	-	-	-	-	1	0	-	0	0	0	1	-	0	-	0	1	-	-	-	0	0	-	3
8	-	-	-	-	1	0	-	1	0	0	1	-	0	-	0	0	-	-	-	0	0	-	0
9	-	-	-	-	0	0	-	0	0	0	0	-	1	-	1	1	-	-	-	0	0	-	2
70	-	-	-	-	0	0	-	0	1	1	0	-	-	-	-	-	-	-	-	1	0	-	2
1	-	-	-	-	0	0	-	1	0	-	0	-	-	-	-	-	-	-	-	-	1	-	1
2	-	-	-	-	0	0	-	-	0	-	1	-	-	-	-	-	-	-	-	-	-	-	0
3	-	-	-	-	0	1	-	-	1	-	0	-	-	-	-	-	-	-	-	-	-	-	2
4	-	-	-	-	0	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
5	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-
7	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	19	21	28	7	60	3	56	21	23	6	42	11	369	5	13	7	13	1	5	9	15	4	116

Appendix table 7. Vertical temperature profiles, G.B. REED cruise, June 6-24, 1983.

Consec. no.	Stn. no.	Day/Mo.	Time (PST)	Position Lat. N	Position Long. W	Bottom depth (m)	Depth (m)/Temperature (°C)
1	1	08/06	0929	51°07.0'	128°20.0'	182	0 10 25 27 28 30 31 35 56 76 82 90 111 180 182 13.0 12.5 12.0 11.5 11.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.5
2	5	08/06	1155	51°24.0'	128°42.5'	215	0 12 14 18 22 25 32 62 104 121 135 144 164 199 215 12.4 12.0 11.5 11.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 6.0
3	8	08/06	1614	51°06.8'	129°37.2'	438	0 16 24 27 51 53 67 73 93 103 140 160 182 260 371 438 12.6 12.0 11.5 11.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.1
4	10	08/06	1937	51°36.0'	130°02.5'	270	0 15 16 21 25 28 36 50 68 69 105 140 197 257 270 12.5 12.0 11.5 11.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.7
5	15	09/06	0213	52°00.0'	130°31.0'	402	0 15 19 25 30 33 37 50 70 97 102 127 160 200 250 380 402 12.5 12.0 11.5 11.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 5.0
6	21	09/06	0835	52°29.7'	130°12.5'	200	0 23 28 30 32 35 40 68 85 101 115 121 138 163 200 12.5 12.0 11.5 11.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.6
7	23	10/06	1700	53°15.5'	130°41.0'	192	0 1 22 25 30 37 51 74 95 100 111 133 144 192 12.2 12.0 11.5 11.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.2
8	41	10/06	1840	53°12.5'	131°06.5'	40	0 5 11 22 40 12.0 11.5 11.0 10.5 10.2
9	39	11/06	1746	53°41.5'	131°13.0'	42	0 10 20 26 34 42 13.0 12.5 12.0 11.5 11.0 10.5
10	33	16/06	1145	54°24.5'	131°23.0'	215	0 50 51 52 54 75 99 125 215 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.7

Appendix table 7 (cont'd)

Consec. no.	Stn. no.	Day/Mo.	Time (PST)	Position		Bottom depth (m)	Depth (m)/Temperature (°C)																
				Lat. N	Long. W																		
11	39	17/06	2052	53°41.5'	131°13.0'	43	0	5	9	13	38	40	43										
							11.0	11.5	12.0	12.5	12.0	11.5	11.5										
12	23	19/06	2205	53°15.5'	130°41.0'	190	0	2	4	5	12	29	33	40	48	63	95	110	120	144	190		
							13.5	13.0	12.5	12.0	11.5	11.0	10.5	10.0	9.5	9.0	8.5	8.0	7.5	7.0	6.5		
13	41	20/06	0657	53°12.5'	131°06.5'	45	0	1	5	12	29	30	30	31	33	45							
							13.3	13.0	12.5	12.0	11.5	11.0	10.5	10.0	9.5	9.2							
14	21	20/06	2215	52°59.7'	130°12.5'	225	0	2	7	9	13	22	27	30	34	50	76	101	115	135	151	165	175	225	
							14.0	13.5	13.0	12.5	12.0	11.5	11.0	10.5	10.0	9.5	9.0	8.5	8.0	7.5	7.0	6.5	6.0	5.7	
15	15	21/06	0418	52°00.0'	130°31.0'	398	0	0	0	5	8	13	15	30	40	45	58	67	85	90	113	140	166	200	280
							14.2	14.0	13.5	13.0	12.5	12.0	11.5	11.0	10.5	10.0	9.5	9.0	8.5	8.0	7.5	7.0	6.5	6.0	5.5
16	10	21/06	0757	51°36.0'	130°02.5'	313	0	0	8	12	16	19	21	22	36	50	68	91	97	133	170	260	313		
							13.5	13.0	12.5	12.0	11.5	11.0	10.5	10.0	9.5	9.0	8.5	8.0	7.5	7.0	6.5	6.0	5.6		
17	8	21/06	1117	51°06.8'	129°37.2'	379	0	0	7	10	17	20	23	30	32	34	47	52	64	76	95	120	164	244	379
							14.5	14.0	13.5	13.0	12.5	12.0	11.5	11.0	10.5	10.0	9.5	9.0	8.5	8.0	7.5	7.0	6.5	6.0	5.5
18	5	21/06	1518	51°24.0'	128°42.5'	218	0	0	2	3	6	22	34	39	48	50	55	75	93	109	120	131	161	218	
							14.5	14.0	13.5	13.0	12.5	12.0	11.5	11.0	10.5	10.0	9.5	9.0	8.5	8.0	7.5	7.0	6.5	6.2	
19	1	21/06	1730	51°07.0'	128°20.0'	181	0	0	2	3	3	4	10	12	22	40	62	75	101	118	181				
							13.4	13.0	12.5	12.0	11.5	11.0	10.5	10.0	9.5	9.0	8.5	8.0	7.5	7.0	6.7				

Appendix table 8. Contents and locations[a] of Shipek bottom grabs completed in Hecate Strait during G.B. REED English sole tagging cruise June 6-24, 1983.

Grab no. GBR83-	Latitude	Longitude	Depth (fm)	Depth (m)	Contents of grab[b]	Contents
1	53°55.0'	131°02.0'	20	37	sG;shell	-
2	53°55.0'	131°09.9'	14	26	shS	2 attempts
3	53°55.1'	131°22.3'	13	24	shS	-
4	53°50.0'	131°21.8'	13	24	sG	-
5	53°50.0'	131°11.4'	14	26	shS	-
6	53°50.0'	131°03.4'	24	44	mS;shell	-
7	53°39.2'	131°05.6'	21	38	shS	-
8	53°25.0'	131°12.1'	16	29	shS	-
9	53°25.0'	131°18.8'	14	26	shS	-
10	53°25.0'	131°25.5'	13	24	gS;shell	-
11	53°25.0'	131°32.5'	12	22	shS	-
12	53°25.0'	131°39.3'	15	27	shS	-
13	53°20.0'	131°32.8'	21	38	S	-
14	53°20.0'	131°25.8'	16	29	sG;shell	2 attempts
15	53°20.0'	131°19.0'	16	29	shG	-
16	53°20.0'	131°12.2'	17	31	shS	some coral
17	53°20.0'	131°05.6'	28	51	sG;shell	-
18	53°15.0'	131°07.1'	22	40	shS	-
19	53°15.0'	131°13.6'	22	40	sG;shell	-
20	53°15.0'	131°20.7'	19	35	shS	-
21	53°15.0'	131°27.5'	14	26	shS	-
22	53°10.0'	131°33.0'	11	20	sG;shell	2 attempts
23	53°10.0'	131°26.0'	15	27	shG	-
24	53°10.0'	131°19.3'	15	27	sG;shell	-
25	53°10.0'	131°12.1'	20	37	gSh	-
26	53°10.0'	131°05.0'	23	42	sG;shell	-
27	53°05.0'	131°07.0'	20	37	shS	-
28	53°05.0'	131°14.2'	17	31	shS	2nd attempt-all shell and not kept.
29	53°05.0'	131°21.0'	14	26	shS	-
30	53°05.0'	131°28.0'	14	26	Sh	-
31	53°00.0'	131°20.0'	11	20	sG;shell	-
32	53°00.0'	131°15.0'	13	24	shS	-
33	53°00.0'	131°10.0'	15	27	sG;shell	-
34	53°00.0'	131°05.0'	13	24	sG;shell	-
35	53°00.0'	131°00.0'	16	29	shS	-
36	53°00.0'	130°55.0'	20	37	sG;shell	-
37	53°00.0'	130°51.0'	35	64	S	-

[a] See Figure 3 for chart with grab locations

[b] G = gravel g = gravelly
M = mud m = muddy
S = sand s = sandy
Sh = shell sh = shelly

Appendix table 9. Identification[a] of invertebrates from Hecate Strait, R/V G.B. REED Cruise, June 6-24, 1983[b].

Phylum porifera (Sponges)
Phylum chidaria (Coelenterates)
Class Anthozoa (Anemones)
Order Actinaria
Order Madreporaria
Anthopleura sp.
Stylatula elongata
Ptilosarcus gurneyi
Phylum Platyhelmenthes (Flatworms)
Class Trematoda (Flukes)
Phylum Nemertinea (Proboscis worms)
Phylum Sipunculida (Peanut worms)
Phylum Annelida (Segmented worms)
Class Hirudinea (Leeches)
Oceanobdella sp.
Oceanobdella pallida
Levinsenia rectangulata
Class Polychaeta (Marine worms)
Family Spionidae
Family Spirorbidae
Family Terbellidae
Aphrodita japonica
Arctonoe pulchra
Cualleriella sp.
Caulleriella alata
Dorvillea pseudorubrovittata
Euclymene sp.
Euclymene sp. cf. zonalis
Glycera capitata
Harmothoe sp.
Harmothoe imbricata
Harmothoe lunulata
Hemipodus borealis
Idanthysus armatus
Laonice cirrata
Macrochaeta pege
Micropodarke dubia
Nepthys caeca
Notomatus lineatus
Nothria sp.
Onuphis elegans
Opiodromus pugettensis
Owenia fusiformes
Owenia fusiformes delle
Pectinaria granulata
Phyllodoce groenlandica
Pista cristata
Scolelepis squamata
Spiophanus bombyx
Spiochaetopterus costarum

Appendix table 9 (cont'd)

Spiophanus costarum
Syllis sp.
Syllis elongata
Syllis spongiphila
Travisa pupa

Phylum Arthropoda (Trilobites)
Class Crustacea (Mandibulates)
Order Decapoda (Shrimp and Crabs)
Cancer sp.
Cancer branneri
Cancer productus
Cryptolithodes typicus
Hemigrapsus nudus
Hemigrapsus oregonensis
Hyas lyatrus
Lopholithodes foraminatus
Mesocrangon munitella
Oregonia gracilis
Pagurus sp.
Pagurus beringanus
Pagurus caurinus
Paguristes sp.
Paguristes turgidus
Order Amphipoda (Amphipods)
Family Ampeliscidae
Family Aoridae
Family Ischyroceridae
Family Isaeidae
Family Lafystiidae
Family Photidae
Family Phoxocephalidae
Family Pleustidae
Family Pontogeneiidae
Family Stenothoidae
Order Isopoda (Isopods)
Rocinela belliceps
Subclass Copepoda (Copepods)
Acanthochondria sp.
Clavella adunca
Clavella irina
Haemobaphes disceraus
Lepeophtheirus pravipes
Lepeophtheirus parviventris
Naobranchia occidentalis
Pandarus bicolor
Phrixocephalus cincinnatus

Phylum Mollusca (Mollusks)
Class Gastropoda (Snails)
Acmaea sp. cf. funiculata
Armina californica
Buccinum scalariforme

Appendix table 9 (cont'd)

Ceratostoma foliatum
Crepidula sp.
Crepidula nummaria
Fusitriton oregonensis
Halistylus pupoides
Ischnochiton sp.
Lepidopleurus sp.
Lepidozona mertensii
Littorina sp.
Littorina sitkana
Margarites sp.
Mitella sp.
Neptunea tabulata
Nitidella gouldi
Notoacmea scutum
Olivella baetica
Propebela turricula
Solariella peramabilis
Turbonilla macouni

Class Bivalvia (Bivalves)

Acila castrensis
Astarte sp.
Axinopsida serricata
Callistoma ligatum
Chlamys sp.
Chlamys sp. cf. rubia
Crepidula nummaria
Crepipatella lingulata
Glycymeris subobsoleta
Hiatella arctica
Macoma brota
Margarites pupillus
Mytilis edulis
Pecten caurinus
Tellina nuculoides

Class Scaphopoda (Tooth shells)

Class Cephalopoda (Cephalopods)

Rossia sp.

Phylum Bryozoa (Lophophores)

Phylum Brachiopoda (Lamp shells)

Phylum Echinodermata (Echinoderms)

Class Echinoidea (Urchins and Sand dollars)

Strongylocentrotus sp.
Strongylocentrotus droebrachiensis

Class Asteroidea (Starfishes)

Crossaster papposus
Gorgonocephalus eucnemis
Hippasteria spinosa
Luidia foliolata
Mediaster aequalis
Orthasterias koehleri

Appendix table 9 (cont'd)

Piaster sp.
Pteraster tesselatus
Pycnopodia helianthoides
Solaster sp. cf. dawsoni
Class Ophiuroidea (Brittle stars)
Ophiopholis aculeata
Ophiura sarsi
Class Holothuroidea (Sea cucumbers)
Parastichopus californicus
Phylum Chordata (Deuterostomes)
Subphylum Tunicata (Tunicates)
Class Ascidiacea (Sea squirts)
Halocynthia igaboja

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[a]Identifiers:
Dr. E. L. Bousfield, National Museum
J. A. Fournier, National Museum
K. Conlan, National Museum
P. Frank, National Museum
Dr. Z. Kabata, Pacific Biological Station
D. Laubitz, National Museum
J. Madill, National Museum
F. Rafi, National Museum
M. F. I. Smith, National Museum

[b]Specimens collected by trawl, SCOR net, neuston sampler, and Shipek grab.

POOR

QUALITY

ORIGINAL